Clinton Lake Water Quality Summary
2006 - 2015

The US Army Corps of Engineers (USACE) Water Quality Program collects monthly water samples at Clinton Lake* from April through September. These figures present data collected between 2006-2015 from lake sites (#2, 6, 12, 18) and the outflow (#1) below the dam. Thirty-four chemical, physical and biological parameters are measured to evaluate water quality. USACE uses this data to describe water quality history, conditions and changes from the inflow streams, within the main lake, and outflow focusing on eutrophication, nutrients, sediment, herbicides, metals, and contaminants.

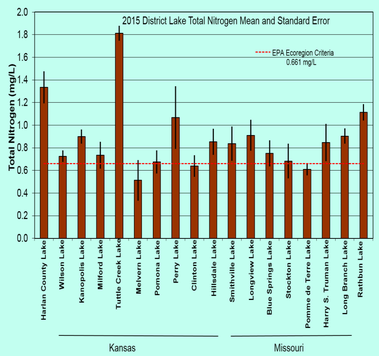
*Note: The term "lake" is substituted for technically correct "reservoir" throughout this document for consistency.

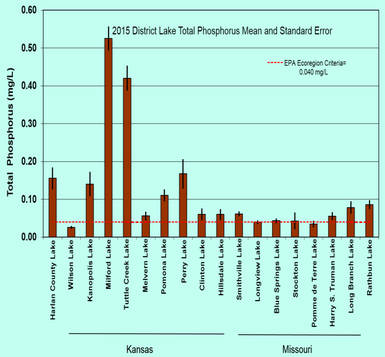
Clinton Lake:

- Located at RM 22.2 of the Wakarusa River
- **Watershed** = 367 sq miles (234,880 Acres)
- **Capacity (2009 sediment survey):**
  - Flood Control: 292,496 Acre Feet (AF) / 13,688 surface acres (SA)
  - Multipurpose: 118,699 AF / 7,205 SA / 82 miles of shoreline
  - Multipurpose pool sediment reserve: 8,299 AF
- **Operating project purposes**: flood control, water quality, recreation, fish and wildlife, and water supply.
- **Avg. annual inflow** (2006-2015)=149,269 AF; **2015 inflow** = 251,497 AF
- **Water Quality** at Clinton Lake in 2015 was beneficial to operating purposes listed above and measured parameters did not exceed KS State WQ Standards for designated uses. Water quality improves as nutrients, herbicides and sediments are removed by settling, dilution, and biological processes as water moves from inflow streams to the dam.

Nutrient Enrichment

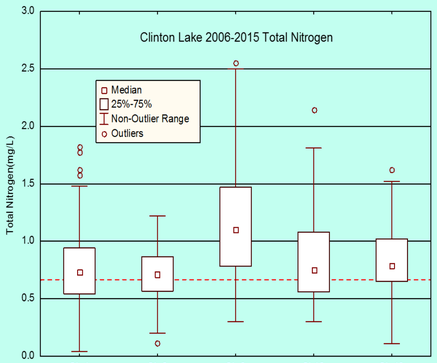
Nutrients (i.e. phosphorus and nitrogen) are essential for aquatic life and the primary factor driving fish and aquatic plant growth rates and productivity. Excess nutrients from urban, agricultural or natural sources increases the natural aging or eutrophication process in lakes. This can alter plant and aquatic life in lakes and water bodies, cause algal blooms, create low dissolved oxygen that affect fish survival, and lead to taste and odor issues in drinking water. Clinton Lake is on the 2016 Ks 303(d) list of impaired waters for eutrophication. EPA and KDHE are working with water quality partners and landowners to focus watershed conservation efforts on priority or target areas in the watershed to reduce nutrient and sediment runoff to meet water quality goals for the upper Wakarusa River and Clinton Lake. In 2015, Clinton Lake average total nitrogen (TN) and total phosphorus (TP) was less than average for all Kansas City District Lakes which calculated to 0.88 mg/L and 0.12 mg/L, respectively. TN average of 0.64 mg/L was less than EPA Ecoregion recommended levels while TP measured at the Clinton Lake dam (CL-2) was slightly more than EPA Ecoregion recommended criteria and below Upper Wakarusa WRAPS 10-year goal. Standard error bars in the graphs below illustrate the variation in sample results from each site in 2015.

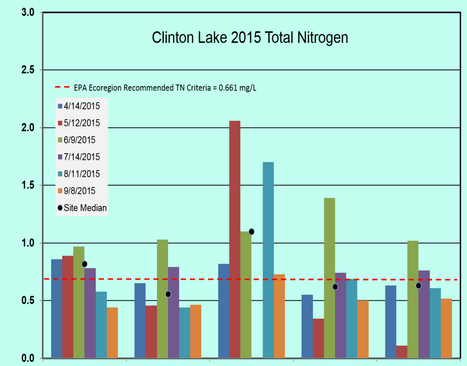




Total Nitrogen

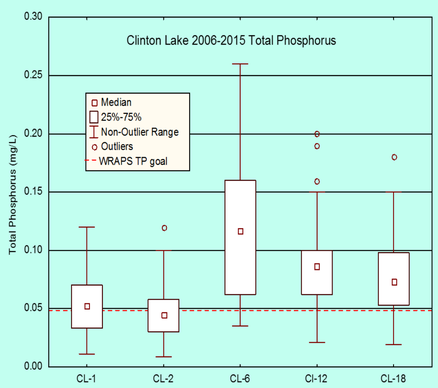
Total nitrogen concentrations are less variable between sites and years at Clinton Lake than most KCD lakes due to stable inflow levels and other watershed factors (i.e. stable soils and farming practices). Clinton Lake is TN average is below the District lake average for in most years including 2015. Nitrogen Median total nitrogen concentrations at Clinton Lake sites were lower than EPA Ecoregion recommended criteria in 3 of 4 lake sites. Total Nitrogen is a combination of inorganic forms which are available for plant/algae growth and the organic forms of nitrogen not immediately available. The spike in TN in May and August at CL-6 was attributed to a high percentage (62%) of nitrates in the samples resulting from large inflows from rain events prior to sampling. The importance of nitrogen in the aquatic environment varies according to the relative amounts of the forms of nitrogen present. Nitrogen compounds change forms frequently as atmospheric and terrestrial sources move into and though the aquatic environment.

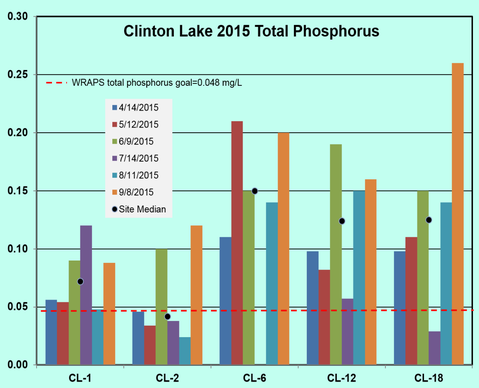




Total Phosphorus

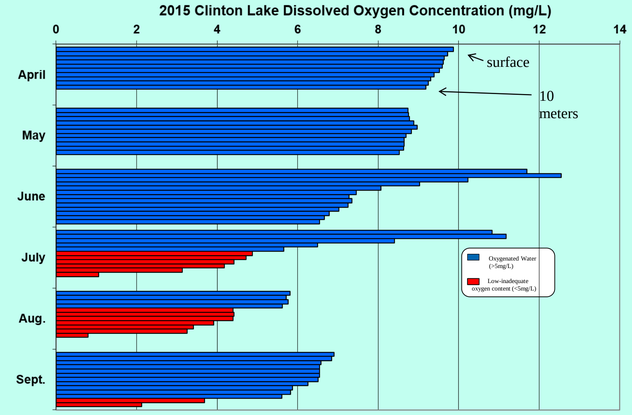
Total phosphorus (TP) median concentrations from 2015 Clinton Lake samples meet WRAPS 10-year average goals for Clinton Lake at site #2 (near the dam). The upper lake sites (Cl-6, Cl-12, and CL-18) were more than two times the goal. Large inflows carried more phosphorus to Clinton Lake than normal. Upper lake sites and outflow TP median values measured higher concentrations of phosphorus than 75% of records from the prior 10-year period at respective sites. Median TP at all Clinton Lake sites are in the range of high biological productivity leading to high algae populations and rapid fish growth as indicated by eutrophic class designation. Signs of internal loading of phosphorus from lake bed sediments was not as apparent in 2015 with frequent external loading events from inflows. Similar to most impoundments, higher TP concentrations and a wider range of data is usually found in the upper lake sites due to inflows and internal loading from nutrient rich bottom sediments while TP decreases from biological uptake as the water moves through the lake to the dam.





Dissolved Oxygen

Dissolved oxygen (D.O.) is an important factor in aquatic species location, growth, and ultimately survival in lakes. Some lakes undergo a process called stratification or develop layers based on temperature and oxygen. This process begins in late spring, remains throughout the summer, and breaks apart (de-stratifies or 'turns over') in the fall. The figure below shows dissolved oxygen measured in the water column in one-meter intervals (e.g. each row in each month represents one meter of depth) from April-September at the dam (CL-2). Clinton Lake typically stratifies during summer months and lack of adequate (<5 mg/L) dissolved oxygen can be a concern. In 2015, Clinton Lake showed stratification July and August. The top 4 meters contained sufficient oxygen for fish and aquatic life. The upper lake sites mix throughout the summer so dissolved oxygen is similar from top to bottom.



Water Quality Concerns:

- Sediment inputs
- Eutrophication
- Dissolved oxygen and shallow depth of stratification

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